

The Anatomy and Systematics of *Latiromitra*, a Genus of Tropical Deep-Water Ptychactractinae (Gastropoda: Turbinellidae)

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Abstract. The anatomy of *Latiromitra* Locard, 1897, is very similar to that of other representatives of the Ptychactractinae, notably in the short or very short proboscis, the presence of an accessory salivary gland, the ventral odontophoral retractor passing through the nerve ring, and the position of the buccal mass at the proboscis base in contracted position. *Latiromitra* differs from *Ceratoxancus* by its fused salivary glands (clearly separate in *Ceratoxancus*). Based on anatomical and conchological characters, *Cyomesus* Quinn, 1981, and *Okinawavoluta* Noda, 1980, are confirmed and/or placed in the synonymy of *Latiromitra*. The genus currently comprises 10 Recent and Neogene species, three in the Atlantic, and seven in the Indo-West Pacific, all in deep water at low latitudes. *Teramachia chaunax* Bayer, 1971, is placed in the synonymy of *Latiromitra cryptodon* (P. Fischer, 1882), and the Recent *Benthovoluta sakashitai* Habe, 1976, is placed in the synonymy of the Pliocene *Latiromitra okinavensis* (MacNeil, 1961). *Volutomitra? vitilevensis* Ladd, 1982 is placed in *Latiromitra*. Three new species are described: *Latiromitra paiciorum* sp. nov. (New Caledonia, 960–1100 m), *L. cacozeliana* sp. nov. (Vanuatu, 536–775 m), and *L. crosnieri* sp. nov. (Madagascar and NE of Fiji, 600–800 m). In addition, *Mitra styliola* Dall, 1927, from off Georgia, USA, is tentatively referred to *Latiromitra*.

INTRODUCTION

The genus *Latiromitra* Locard, 1897, erected for the single species *L. specialis* Locard, 1897, was originally placed in the family Pisanidae (= Buccinidae). Thiele (1929) transferred the genus to Vexillinae [= Costellariidae], a position accepted by Ponder (1968), while Cernohorsky (1970) considered it a subgenus of *Volutomitra* H. & A. Adams, 1853 (Volutomitridae). Bouchet & Warén (1985) assigned *Latiromitra* to the Turbinellidae, based on the radula of *L. barthelowi* (Bartsch, 1942), and synonymized *Cyomesus* Quinn, 1981. Harasewych (1987), while classifying *Latiromitra* and *Ceratoxancus* Kuroda, 1952, under Turbinellidae Ptychactractinae, expressed doubts about their taxonomic position, due to the lack of knowledge of the radula of their type species. Harasewych also disagreed with Bouchet & Warén's (1985) synonymizing *Latiromitra* and *Cyomesus*. Thus the position of *Latiromitra* has remained controversial, mainly due to the lack of anatomical data.

Although known for a long period only from the holotype, *Prodallia barthelowi* has been referred to many times in the literature, and its taxonomic position changed several times. Bayer (1971) was the first to classify it as a turbinellid, although he mistakenly placed it in the volutid genus *Teramachia* Kuroda, 1931 [= *Calliotectum*

Dall, 1890, see Bouchet & Poppe, 1995]. Bouchet & Warén (1985) examined a specimen from the Philippines and presented a drawing of the radula. Based on conchological similarity with *Latiromitra cryptodon*, they placed *Prodallia barthelowi* in *Latiromitra* and confirmed its assignment in the Turbinellidae.

Material of the genus has since been collected alive, including specimens of the type species. In the present paper, we report on the anatomy of *Latiromitra* and confirm its placement in the family Turbinellidae. We also review the species included in *Latiromitra*, describe new species from off Madagascar, New Caledonia, and Vanuatu, and confirm the synonymization of *Cyomesus*. The present paper follows our earlier revision of *Ceratoxancus* (Kantor & Bouchet, 1997).

Abbreviations and text conventions: ag, anal gland; asg, accessory salivary gland; ca, buccal cavity; ct, ctenidium; cu, cuticle; dasg, duct of accessory salivary gland; dd, dead collected specimen; ddg, duct of digestive gland; dg, digestive gland; gL, gland of Leiblein; lv, live collected specimen; moe, glandular mid-esophagus; ne, nephridium; nr, nerve ring; od, odontophore; oe, esophagus; op, operculum; os, osphradium; p, penis; poe, posterior esophagus; pr, proboscis; prs, rhynchodaeum (= proboscis sheath); r, radular membrane; rs, radular sac; s,

siphon; sd, salivary duct; sem.gr, open seminal groove; sem.p, seminal papilla; sg, salivary gland; st, stomach; t, head tentacle; tes, testis; tu, buccal tube; vL, valve of Leiblein; vpr, ventral proboscis retractor.

Repositories: BMNH, The Natural History Museum, London; MNHN, Muséum national d'Histoire naturelle, Paris; MOM, Musée Océanographique de Monaco; NSMT, National Science Museum, Tokyo; UMML, Invertebrate Museum, Rosenstiel School of Marine & Atmospheric Sciences, University of Miami; USNM, National Museum of Natural History, Smithsonian Institution, Washington DC.

ANATOMY

Alcohol preserved material has been obtained for two species, the anatomy of which is very similar. Specimens with dry soft parts have permitted examination of the radula in two additional species.

Latiromitra cryptodon

The dissected specimen (Brazil, MD55, sta. CB79) has a shell height of 21.6 mm, last teleoconch whorl height 14.8 mm, aperture height 7.7 mm, siphonal canal height 2.7 mm, shell diameter 8.4 mm. After removal of the odontophore with radula, the organs of the body haemocoel were serially sectioned.

External anatomy (Figure 1A, B): The body consists of three whorls; the mantle cavity spans 0.75 whorl; the nephridium 0.3 whorl; and the digestive gland 1.25 whorl. The body is pale yellowish, it lacks pigmentation except for a small portion of the mantle near the siphon and head tentacles, which bears very small black spots. The operculum is large (Figure 1A—op), occupying 0.75× aperture height, narrow, subrectangular, very thin, flexible, transparent, and yellow. The columellar muscle is attached on the upper fourth of the operculum. The foot is short ($L/W \approx 1.5$). The siphon is short, simple, slightly protruding beyond the mantle edge. The columellar muscle is thick, consisting of 1.5 whorls, with three rather deep grooves, corresponding to the columellar teeth. The mantle is thin, the mantle cavity organs clearly visible through it. The mantle is short, not covering the head base and penis. The head is broad, with very short, stout tentacles and very large eyes.

Mantle cavity: The entire mantle cavity was filled with a thick unremovable layer of hypobranchial gland secretion; it was impossible to examine the morphology of the mantle cavity in detail. The ctenidium is very long and occupies nearly the entire mantle cavity length, narrow ($L/W \approx 7$) with high hanging leaflets. The osphradium is large, 0.75× as long as the ctenidium. The anal gland is small, visible through the mantle as a narrow dark strip.

Digestive system: The organs of the body haemocoel are

compact, and their *in situ* position resembles that of *Ceratoxancus teramachii* (Kantor & Bouchet, 1997). The contracted proboscis (Figure 1D—pr) is short (about 1 mm long, or 13% of aperture height), smooth, and occupies nearly the whole rhynchodeal cavity. The rhynchodeum (= proboscis sheath) is thin-walled and lined with a tall epithelium. The moderate-sized paired muscles, probably functioning as proboscis retractors, are attached latero-ventrally to the anteriormost part of the rhynchodeum (Figure 1F—vpr). This indicates that the whole rhynchodeum takes part in the proboscis eversion, and when the proboscis is completely everted, these retractors are attached to the inner wall of the proboscis.

The buccal cavity is broad and lined with a thick cuticle. The buccal mass is large, broad, and muscular, and projects ventrally beyond the rear of the retracted proboscis (Figure 1F—od). The ventral odontophoral retractor passes through the nerve ring, follows the bottom of the cephalic haemocoels, and joins the columellar muscle.

The radula (Figure 3A–C) is about 1.6 mm long (7.4% of shell height and 20% of aperture height) and about 107 μm wide (0.49% of shell height and 1.39% of aperture height). The radula projects beyond the rear of the proboscis, and consists of more than 80 transverse rows. The rachidian teeth (Figure 3B) bear three cusps that are curved in profile, the central one 1.5× as long as the lateral cusps. The cusps emanate from close to the anterior edge of the basal part. The basal part of the rachidian has a rather deep notch on the anterior edge. The lateral teeth are unicuspid, with a long narrow base. The length of the lateral tooth base equals 0.80× the rachidian width.

After leaving the proboscis the esophagus forms a very short loop before opening into the valve of Leiblein (Figure 1D—vL). The valve of Leiblein is well defined, much broader than the esophagus, and oval-pyriform. It has a conical ciliar valve, similar to that in Muricidae. Between the valve and the opening of the gland of Leiblein the esophagus is widened and has well-developed dorsal glandular folds. This part, representing the mid-esophagus, is long (ca. 2.3× proboscis length). The posterior esophagus runs along the left side of the gland of Leiblein and opens into the stomach.

The stomach is very small by comparison to the anterior foregut, and broadly U-shaped. The fixation of the specimen does not permit examination of the inner anatomy of the stomach. Judging from the external view, the stomach has a small caecum. Typhlosoles of even size can be seen through the stomach wall.

The gland of Leiblein is large, gray in the fixed specimen, tubular, coiled anteriorly, and simple posteriorly. The gland opens into the esophagus through a duct without defined constriction (Figure 1E).

The salivary glands are fused, compact, flattened, and cover the posterior proboscis sheath dorsally. When the organs of the body haemocoel are extended, the glands

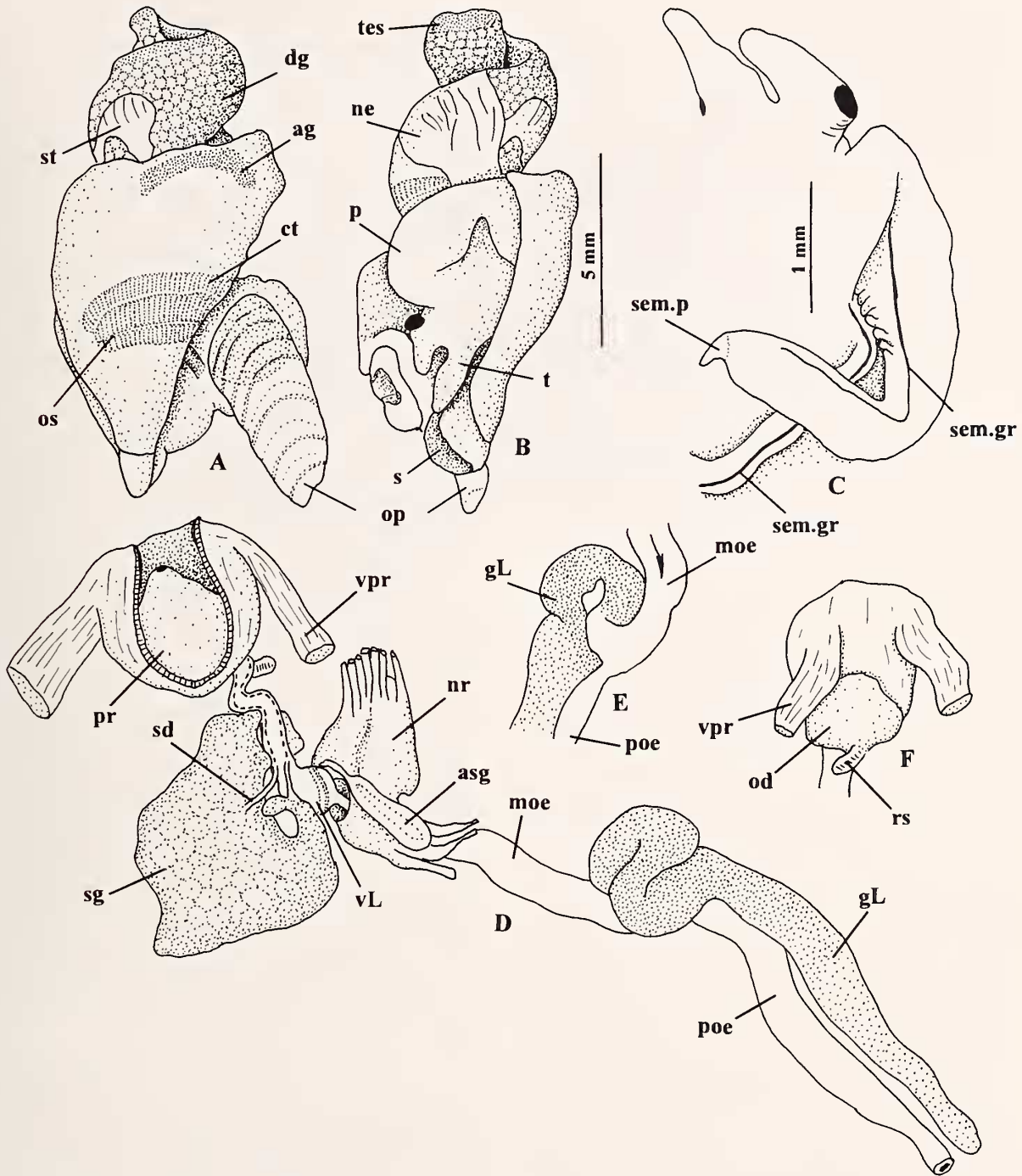


Figure 1

Anatomy of *Latiromitra cryptodon*, male (Brazil, MD55, sta. CB79, shell height 21.6 mm). A, B. Body, removed from the shell. C. Anterior part of the body with the mantle removed to show the penis and seminal groove. D. Organs of the body haemocoel, expanded. E. Opening of the gland of Leiblein into the esophagus, from the ventral side. F. Proboscis sheath with odontophore, from the ventral side. C–F, in the same scale.

lie above the nerve ring and embrace the valve of Leiblein (Figure 1D—sg). Immediately after leaving the glands, the salivary ducts enter the walls of the esophagus in front of the valve of Leiblein. The ducts follow in the walls of the esophagus to their opening in the buccal cavity (on the drawing they are shown by dashed lines). There is a medium-sized unpaired accessory salivary gland, situated on the right side of the nerve ring (Figure 1D—asg). Gland histology is typical for neogastropods, consisting of a thick outer epithelial layer and a thin inner one, delimited by a layer of circular muscle fibers. The duct of the gland opens ventrally in the anterior part of the buccal tube.

The highly concentrated circumesophageal nerve ring is situated in the position typical for Muricoidea, just posterior to the valve of Leiblein (Figure 1D—nr).

Male reproductive system (Figure 1C): The dissected specimen was a mature male. The pallial portion of the system is represented by a muscular open groove, running anteriorly to the base of the rather long penis and then along its inner lateral edge to a medium-sized, conical papilla.

Latiromitra barthelowi

The largest specimen was anatomically studied (Indonesia, KARUBAR, sta. CC41). It has a shell height of 52.0 mm, last teleoconch whorl height 31.3 mm, aperture height 17.4 mm, siphonal canal height 6.0 mm, shell diameter 17.7 mm. The foot with the anterior foregut was serially sectioned. The radula has been studied on a specimen from Indonesia (KARUBAR, sta. CP72). It has a shell height of 48.7 mm, last teleoconch whorl height 29.0 mm, aperture height 16.4 mm, siphonal canal height 5.5 mm, shell diameter 15.3 mm.

External anatomy: The upper part of the body was torn off during extraction from the shell. The remaining part consists of 1.3 whorls; the mantle cavity spans 0.75 whorl. The body is pale yellowish, lacking differential pigmentation. The operculum is small, about 0.3× aperture height, narrow-leaf shaped and slightly curved, with terminal nucleus (Figure 2B). The foot is short (L/W ≈ 1.5). The siphon is short, simple, slightly protruding beyond the mantle edge. The columellar muscle is thick, consisting of about 1.5 whorls, with two deep grooves, corresponding to the columellar teeth. The mantle is rather thin, covering the head base, the mantle cavity organs clearly visible through it. The head is broad, with long cylindrical tentacles and large eyes.

Mantle cavity: The ctenidium is very long and occupies nearly the whole mantle cavity length, narrow (L/W ≈ 10.5), with high hanging leaflets. The ctenidial lamellae have the form of tall triangles. The osphradium is large, 0.5× as long and 1.5× as wide as the ctenidium, asymmetrical with the right side nearly twice as broad as the

left. The hypobranchial gland is covered with a thick mucus layer and is transversely plated. The rectum opens close to the mantle edge. The anal gland is not visible.

Digestive system: The general arrangement of the anterior digestive system is very similar to that of *Latiromitra cryptodon*. The proboscis is short, about 2 mm long (11% of aperture height), with folded walls, and occupies about two-thirds of the rhynchodeal cavity.

The rhynchodaeum is thin-walled, and lined with very tall epithelium. The moderate-sized paired muscles, functioning as proboscis retractors, are attached ventrally to the anterior part of the rhynchodaeum and join the columellar muscle.

The buccal mass is large (Figure 2A—od), broad, and muscular, projecting ventrally beyond the rear of the retracted proboscis. The radular diverticulum opens in the posterior part of the proboscis into the broad buccal cavity. The buccal tube (Figure 2A—tu) is lined with very thick cuticle (Figure 2A—cu), and leads from the mouth opening to the buccal cavity (Figure 2A—ca). The length of the buccal tube is at least one-third of the length of the proboscis.

The radula (Figure 3D–F) is about 4.6 mm long (9% of shell height and 28% of aperture height), about 250 μm wide (width 0.51% of shell height and 1.4% of aperture height) and consists of about 130 rows. The rachidian tooth, with a short arched base (Figure 3E), bears three short obtuse cusps, emanating from close to the anterior edge of the basal part, the central cusp being longest and widest. The rachidian basal parts have a shallowly arched anterior edge and a rounded posterior edge, which is overlapped by the following tooth. The posterior corners of the rachidian tooth are narrow, thin projections (Figure 3E, F) that join the subradular membrane. The laterals are similar in shape to those in *L. cryptodon*. The length of the lateral tooth base equals 0.60× the rachidian width.

The subradular cartilages are paired, not fused anteriorly, projecting beyond the base of the retracted proboscis. The thin ventral odontophore retractor passes through the nerve ring to join the columellar muscle.

After leaving the proboscis, the esophagus forms a very short loop before opening into the large oval valve of Leiblein. The dorsal glandular folds of the mid-esophagus are well developed. The gland of Leiblein is large, tubular, coiled in its anterior part, and simple posteriorly, opening into the esophagus without visible narrowing of the duct. The inner cavity of the gland of Leiblein is subdivided by the projections of the walls into numerous small chambers.

The salivary glands are fused, large, and acinous. The border between them is not visible. They are compact, flattened, situated above the nerve ring, and embrace the valve of Leiblein, also covering the posterior proboscis sheath dorsally. Immediately after leaving the glands, the

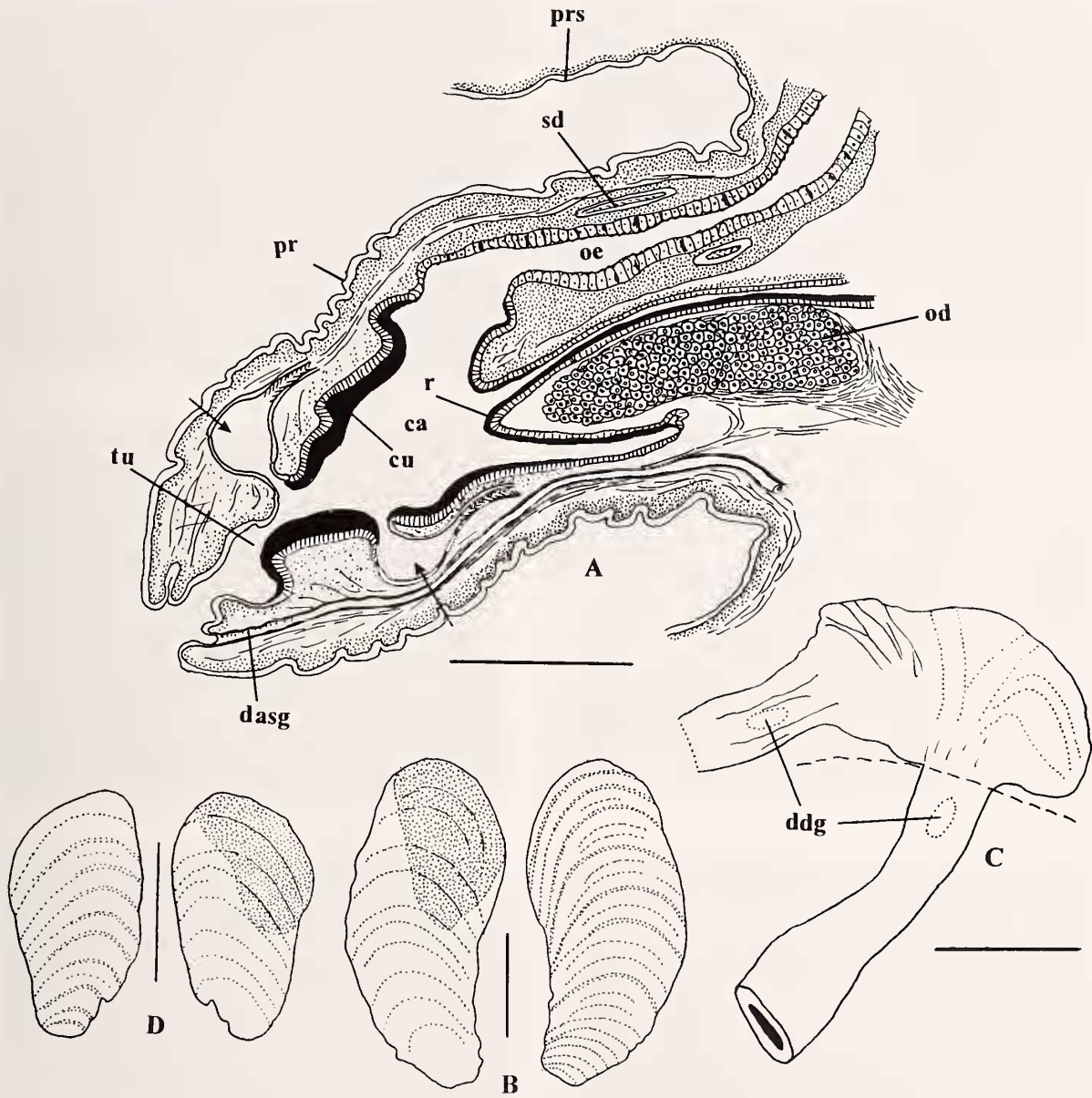


Figure 2

A. Longitudinal semidiagrammatic section of the proboscis of *Latiromitra barthelowi* (Indonesia, KARUBAR, sta. CC41, male, shell height 52.0 mm), scale bar 0.5 mm. B. Operculum from the inner side (at the left) and from the outer side (at the right). The place of columellar muscle attachment is dotted, scale bar 2 mm. C. Stomach from the outside; the dashed line represents the border of the lobe of the digestive gland; the openings of the ducts of the digestive gland at the inner surface of the stomach are shown by dotted circles, scale bar 2 mm (B, C, Indonesia, KARUBAR, sta. CP39, shell height 47.2 mm). D. Operculum of a paratype of *L. crosnieri* Bouchet & Kantor, sp. nov. from the outer side (at the left) and from the inner side (at the right). The place of columellar muscle attachment is dotted, scale bar 2 mm.

salivary ducts enter the walls of the esophagus in front of the valve of Leiblein. The ducts follow in the walls of the esophagus to their opening in the buccal cavity. The place of opening of the ducts is shifted anteriorly from

the opening of the radular diverticulum. One duct opens ventrally, the other dorsally. Near their opening, the ducts are greatly widened and form the "ampullas" lined with smooth epithelium (marked by the arrows on Figure 2A).

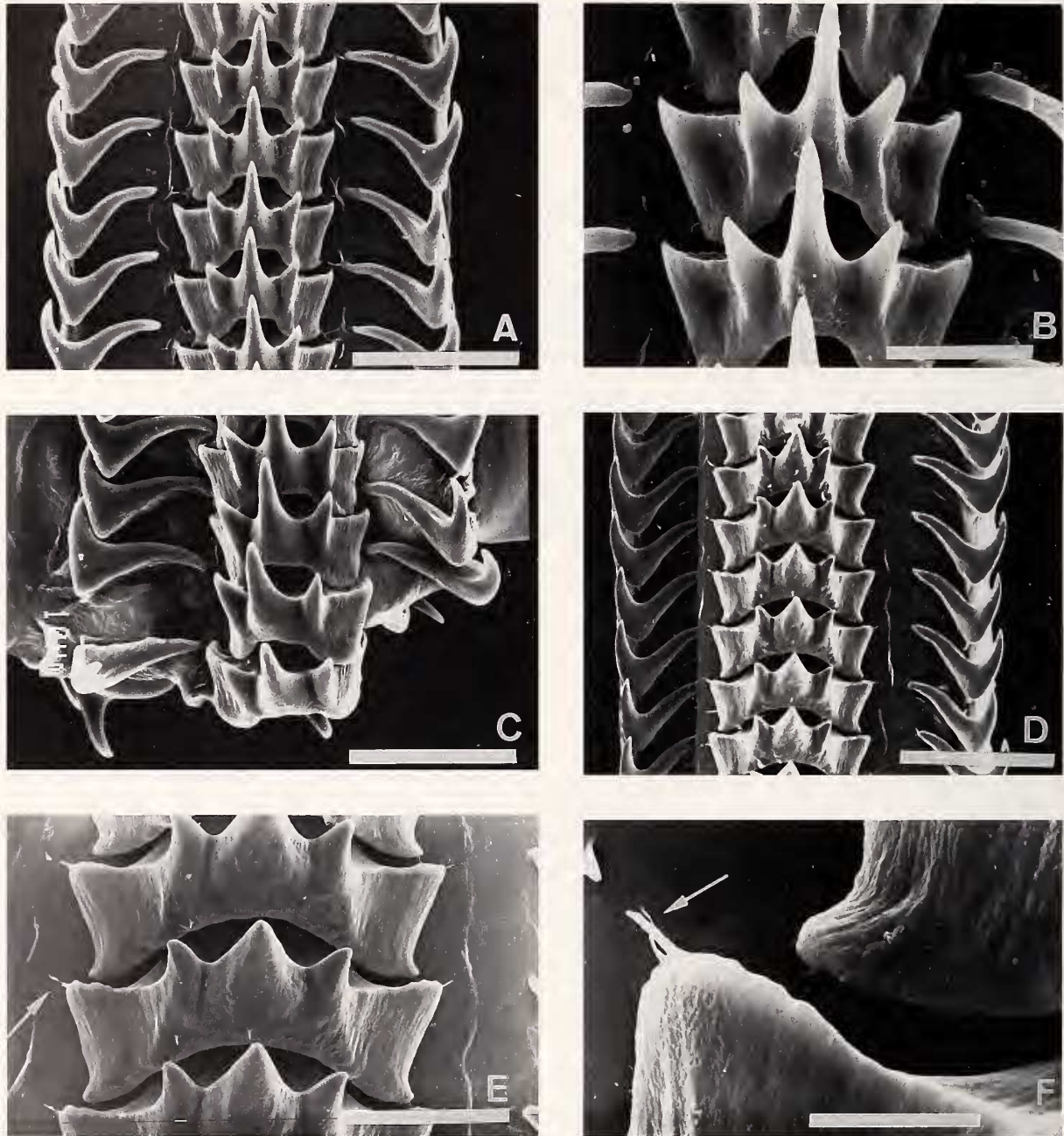


Figure 3

Radulae of *Latiromitra* spp. *Latiromitra cryptodon* (A–C) (Brazil, MD55, sta. CB79): A. Dorsal view of the radular ribbon. B. Enlarged rachidian teeth. C. Bending plane of the radular ribbon. *Latiromitra barthelowi* (D–F) (Indonesia, KARUBAR, sta. CC72): D. Dorsal view of the radular ribbon. E. Enlarged rachidian teeth. F. Enlarged posterior corners of the rachidian tooth. Arrows on E, F show projections that join the subradular membrane. Scale bars 100 μm (D); 50 μm (A, C, E); 20 μm (B); 10 μm (F).

These ampullas open into the buccal cavity with rather narrow ducts.

The accessory salivary gland is very large, tubular, coiled anteriorly, and situated at the right-posterior and

ventral sides of the proboscis sheath. The gland histology is typical for the neogastropods, consisting of a thick outer epithelial layer and a thin inner one, delimited by a layer of circular muscle fibers. The duct of the gland

opens ventrally in the anterior part of the buccal tube (Figure 2A—dasg).

The stomach (KARUBAR, sta. CP39) is relatively small, broadly U-shaped with a short caecum (Figure 2C). The posterior part of the esophagus and its entrance into the stomach is covered with the lobe of the digestive system (the border of the lobe is marked by dashed line on Figure 2C). The ducts of the digestive gland are paired and small. The first is situated near the entrance of the esophagus into the stomach, the second near the opening of the rectum (shown by dashed circles in Figure 2C).

Male reproductive system: One of the specimens with a dried body (KARUBAR, sta. CP39) was rehydrated and appeared to be a mature male. The pallial portion of the system is represented by a muscular open groove, running anteriorly to the base of the penis (which is as long as the entire mantle cavity) and then along its inner lateral edge to the tip. The poorly preserved material does not show details of the penis tip, but it seems to be similar to that of *Benthovoluta claydoni* (Harasewych, 1987: fig. 26).

Latiromitra crosnieri sp. nov.

The operculum of the paratype (shell height 30.4, aperture height 12.4 mm) is about 3.6 mm (0.30× aperture height), transparent, yellowish, narrowly leaf-shaped, and with a terminal nucleus, which is missing (Figure 2D).

The radula of one paratype was studied (Figure 4A–C). It is about 2.7 mm long (9% of shell height and 17% of aperture height), and consists of about 105 rows, narrow, width about 115 μm (0.38% of shell height and 0.92% of aperture height). The rachidian teeth (Figure 4B) bear three cusps that are curved in profile, the central one 1.3× as long as the lateral cusps. The cusps emanate from close to the anterior edge of the basal part. The basal parts of the rachidian have a shallow notch on the anterior edge and a rounded posterior edge, which is overlapped by the following tooth (Figure 4B, C). The laterals are similar in shape to those in *L. cryptodon*, unicuspid, with a long narrow base. The length of the lateral tooth base equals 0.70× the rachidian width. Teeth on the working surface are rather worn. On Figure 4C the teeth from the bending plane are illustrated to show the shape of the posterior edge of the rachidians.

Latiromitra okinavensis

The radula of the specimen with shell height 47.5 mm and aperture height 17.7 mm was studied (Figure 4D–F). It is about 3.1 mm long (6.5% of shell height and 17.5% of aperture height), and consists of about 110 rows, width about 240 μm (0.51% of shell height and 1.35% of aperture height). The rachidian tooth bears three short obtuse cusps, emanating from close to the anterior edge of the basal part, the central cusp being longest. The rachi-

dian basal parts have a shallowly arched anterior edge and a rounded posterior edge, which is overlapped by the following tooth. A damaged tooth is illustrated (Figure 4F) to show the shape of the posterior edge. Laterals are similar in shape to those in *L. cryptodon*. The height of the lateral tooth base equals 0.70× the rachidian width.

SYSTEMATICS

Genus *Latiromitra* Locard, 1897

Type species: (by monotypy) *Latiromitra specialis* Locard, 1897 [= *Mitra cryptodon* P. Fischer, 1882], Recent, tropical Atlantic, bathyal.

Synonyms: *Okinawavoluta* Noda, 1980:33. (syn. nov.) Type species: (by original designation) *Benthovoluta okinavensis* MacNeil, 1961, Pliocene–Recent.

Cyomesus Quinn, 1981:72,73. Type species: (by original designation) *Fasciolaria (Mesorhytis) meekiana* Dall, 1889, Recent.

Diagnosis: Ptychactractinae with fusiform shell, predominantly axial sculpture, early teleoconch whorls shouldered at intersection between axial ribs and spiral cord, shoulder cord becoming obsolete on subadult and adult whorls; persistence of axial sculpture on adult whorls variable in different species. No labral spine or labral spine fasciole. Aperture high, siphonal canal short, broad. Columella with three plaits, the adapical one stronger.

Latiromitra cryptodon (P. Fischer, 1882)

(Figures 1, 3, 5, 10)

Mitra cryptodon P. Fischer, 1882:273.

Synonyms:

Latiromitra specialis Locard, 1897:321, pl. 14, figs 30–34.

Teramachia chaunax Bayer, 1971:198, figs 54 (right), 55B–C. (syn. nov.)

Other references:

Latiromitra cryptodon: Bouchet & Warén, 1985:255, figs 675, 676.

Teramachia chaunax: Rehder, 1972:8; Abbott, 1974:243; Bouchet & Poppe, 1995:504.

Benthovoluta chaunax: Cernohorsky, 1973:127.

Cyomesus chaunax: Quinn, 1981:74, fig. 3 (holotype illustrated).

Type material: *Mitra cryptodon* and *Latiromitra specialis*: objective synonyms, based on the same two syntypes in MNHN. *Teramachia chaunax*: holotype USNM 701216.

Type locality: *Mitra cryptodon* and *Latiromitra specialis*: off Morocco, 33°09'N, 09°38'W, 1900 m [R/V *Tra-vaillieur* 1882, dr. 40]. *Teramachia chaunax*: off St Lucia, 13°45.5'N, 61°05.7'W, 201–589 m [R/V *John Elliott Pillsbury*, sta. P-904].

Material examined: The type material.

MOROCCO. R/V *Hirondelle*, sta. 116, 31°43'N,

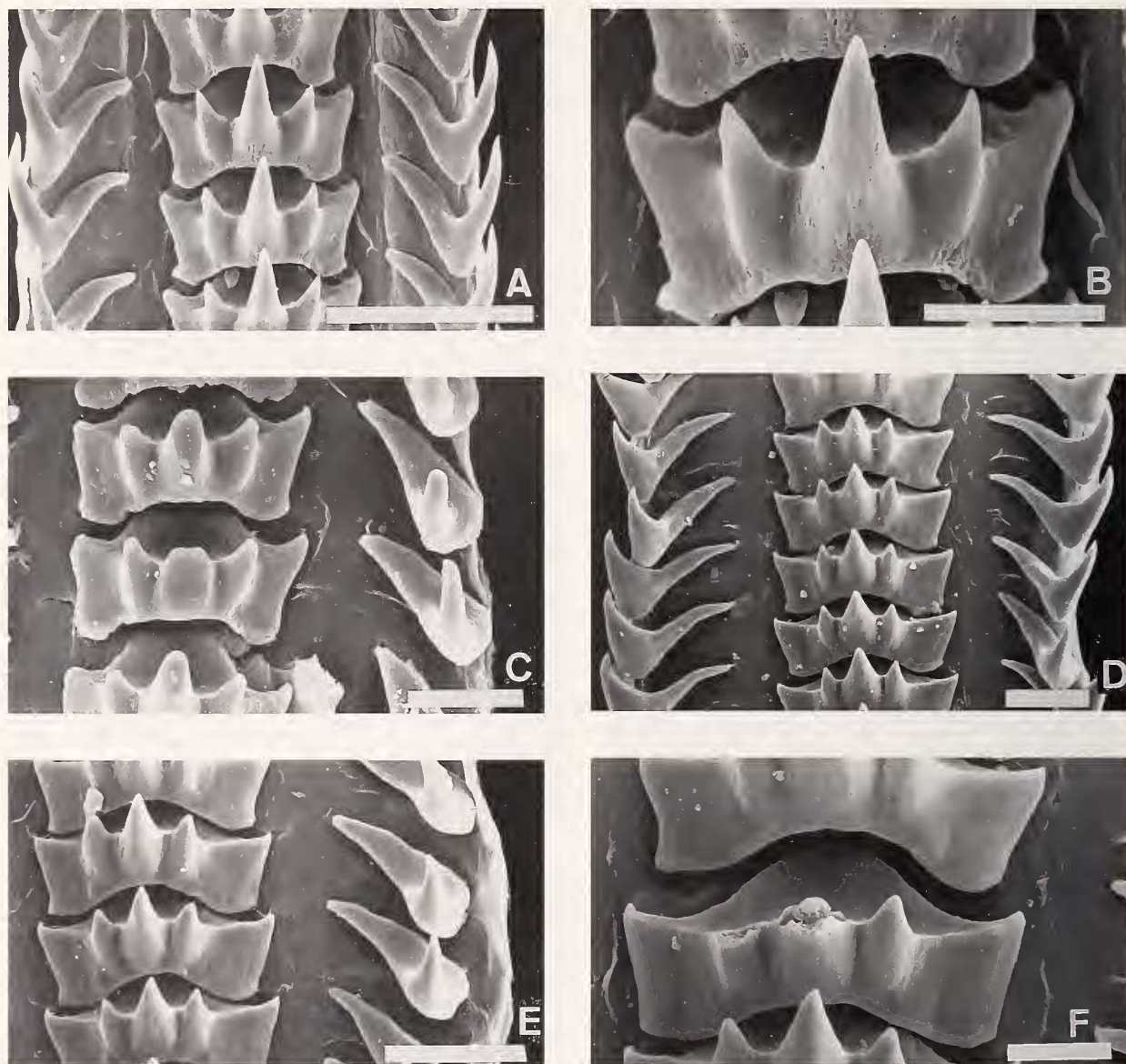
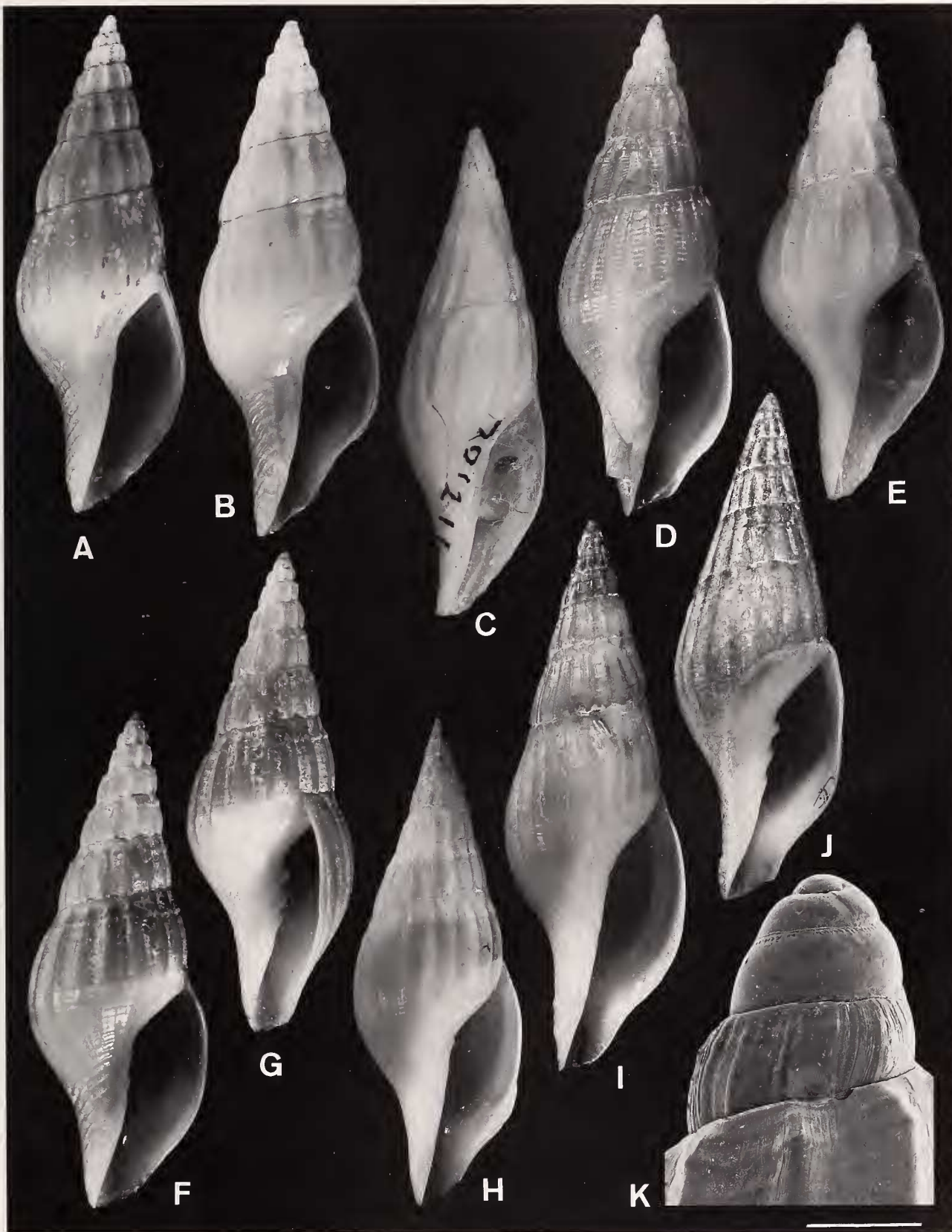


Figure 4

Radulae of *Latiromitra* spp. *Latiromitra crosnieri* Bouchet & Kantor, sp. nov. (A–C) (paratype, Madagascar, R/V *Vauban*, chalutage 22): A. Dorsal view of the radular ribbon. B. Enlarged rachidian teeth. C. Radular teeth at the bending plane of radular ribbon. *Latiromitra okinavensis* (D–F) (paratype of *B. sakashitai*, NSMT-Mo 52581). D. Dorsal view of the radular ribbon. E. Enlarged rachidian teeth and right row of raised lateral teeth. F. Damaged rachidian tooth, showing the shape of the basal part. Scale bars 50 μm (A, D, E); 20 μm (B, C, F).

Figure 5

Latiromitra cryptodon. A, B. Syntypes of *Mitra cryptodon* (MNHN, shell height 30.0 mm); C. Holotype of *Teramachia chaunax* (USNM 701216, shell height 27.9 mm). D. Central Atlantic, Tyro Bank (SEAMOUNT 2, sta. DW276, shell height 26.5 mm). E. Brazil (MD55, sta. CB79, shell height 20.2 mm). F, G. Brazil (MD55, sta. CB79, shell height 22.5 mm) (G, shell turned to show the columellar plaits). H. Bahamas (R/V *Columbus Iselin*, sta. 54, shell height 37.6 mm, UMML 30.8272). I. Bahamas (R/V *Columbus Iselin*, sta. 309, shell height 43.5 mm, UMML 30.9909). J. Bahamas (R/V *Columbus Iselin*, sta. 156, shell height 37.5 mm, UMML 30.8265). K. Protoconch (same specimen as E, scale bar 500 μm).



10°47'W, 2165 m, 1 dd (MOM).—R/V *Discovery*, sta. 8968, 31°35'N, 11°02'W, 1767–1846 m, 1 lv (BMNH).

CENTRAL ATLANTIC. The Azores, R/V *Princesse-Alice*, sta. 683, 38°20'N, 28°05'W, 1550 m, 1 dd (MOM).—SEAMOUNT 2, Tyro Bank, R/V *Suroit*, sta. DW276, 34°02'N, 28°19'W, 1520 m, 1 lv (MNHN).

BAHAMAS. R/V *Columbus Iselin*, sta. 54, 23°54'N, 77°13'W, 1298 m, 1 dd (UMML 30.8272).—Sta. 79, 23°51'N, 76°51'W, 1289 m, 1 dd (UMML 30.8262).—Sta. 156, 23°44.4'N, 76°48.3'W, 1334 m, 1 dd (UMML 30.8265).—Sta. 309, 23°44'N, 76°47'W, 1313 m, 1 dd (UMML 30.9909).

BRAZIL. MD55: R/V *Marion-Dufresne*, sta. CB78, 18°59'S, 37°48'W, 1200 m, 2 dd (MNHN).—Sta. CB79, 19°02'S, 37°48'W, 1500–1575 m, 2 lv [1 dissected], 6 dd (MNHN).

Distribution: Off Morocco and the Azores (Bouchet & Warén, 1985), now extended to the Caribbean and SE Brazil (Figure 10), collected alive in 1500–1850 m.

Description: Shell slender, fusiform, solid, consisting of 2.5 protoconch and 7.5 teleoconch whorls. Protoconch I with large smooth nucleus, diameter 640 µm (Figure 5K); protoconch II consisting of 2.0 convex whorls, smooth, with a subsutural row of coarse granules and a basal keel that is covered by successive whorls, and one to four opisthocyrt incremental riblets before the protoconch/teleoconch discontinuity. Diameter of protoconch II about 1320 µm. Teleoconch whorls convex, with slightly adpressed suture. Sculpture predominantly axial, consisting of solid orthocline ribs, weaker and slightly opisthocline adapically above shoulder cord. The number of axial ribs increases from ca. 10 on the first to third teleoconch whorls to 18–24 on last adult whorl. First teleoconch whorl with five or six weaker spiral cords; the one at shoulder is stronger and persists until penultimate or last adult whorl; other spiral cords usually become obsolete after second whorl. Last adult whorl with spiral grooves, indistinct above periphery, ca. 20, stronger toward base and siphonal canal, where they delimit spiral cords of equivalent breadth. Aperture ovoid, elongate, ca. 50% of total shell height. Outer lip thin, straight. Siphonal canal broad, long but indistinctly set off. Columella with three

plaits, seen when shell is rotated clockwise, adapical one stronger.

Color creamy to slightly orange-white, periostracum brownish. Protoconch yellowish. Dimensions: [measurements from syntype] height 30.0 mm, last teleoconch whorl height 19.0 mm, aperture height 11.0 mm, siphonal canal height 4.3 mm, diameter 10.0 mm. Largest specimen, height 55 mm.

Remarks: Caribbean specimens identified as *Teramachia chaunax* reach a larger adult size, up to 55 mm, and are more slender than specimens from the NE Atlantic or off Brazil. However, the protoconchs and patterns of teleoconch sculpture are identical, and there is no doubt that a single tropical Atlantic species is involved.

Latiromitra meekiana (Dall, 1889) **comb. nov.**

(Figures 6 B–D, 10)

Fasciolaria (*Mesorhytis*) *Meekiana* Dall, 1889a: 172, pl. 36, fig. 7; 1889b: 112, pl. 36, fig. 7.

Other references:

Fasciolaria (*Mesorhytis*) *meekiana*: Johnson, 1934:127; Rehder, 1972:8.

Mesorhytis meekiana: Cernohorsky, 1970:52; 1972:218.

Teramachia meekiana: Bayer, 1971:197, figs. 54 (left), 55 D, E; Bouchet & Poppe, 1995:504.

Benthovoluta meekiana: Cernohorsky, 1973:127, fig. 2.

Cyomesus meekianus: Quinn, 1981:73, 74, fig. 1 (holotype illustrated).

Type material: Lectotype, designated by Quinn (1981), USNM 86970.

Type locality: Cuba, off Morro Light, La Habana, 732 m [R/V *Blake*, sta. 100].

Material examined: The lectotype.

CARRIBEAN SEA. R/V *John Elliott Pillsbury*, sta. 1225, 17°42.5'N, 77°58'W, 457–558 m, 1 dd (UMML 30.8260).

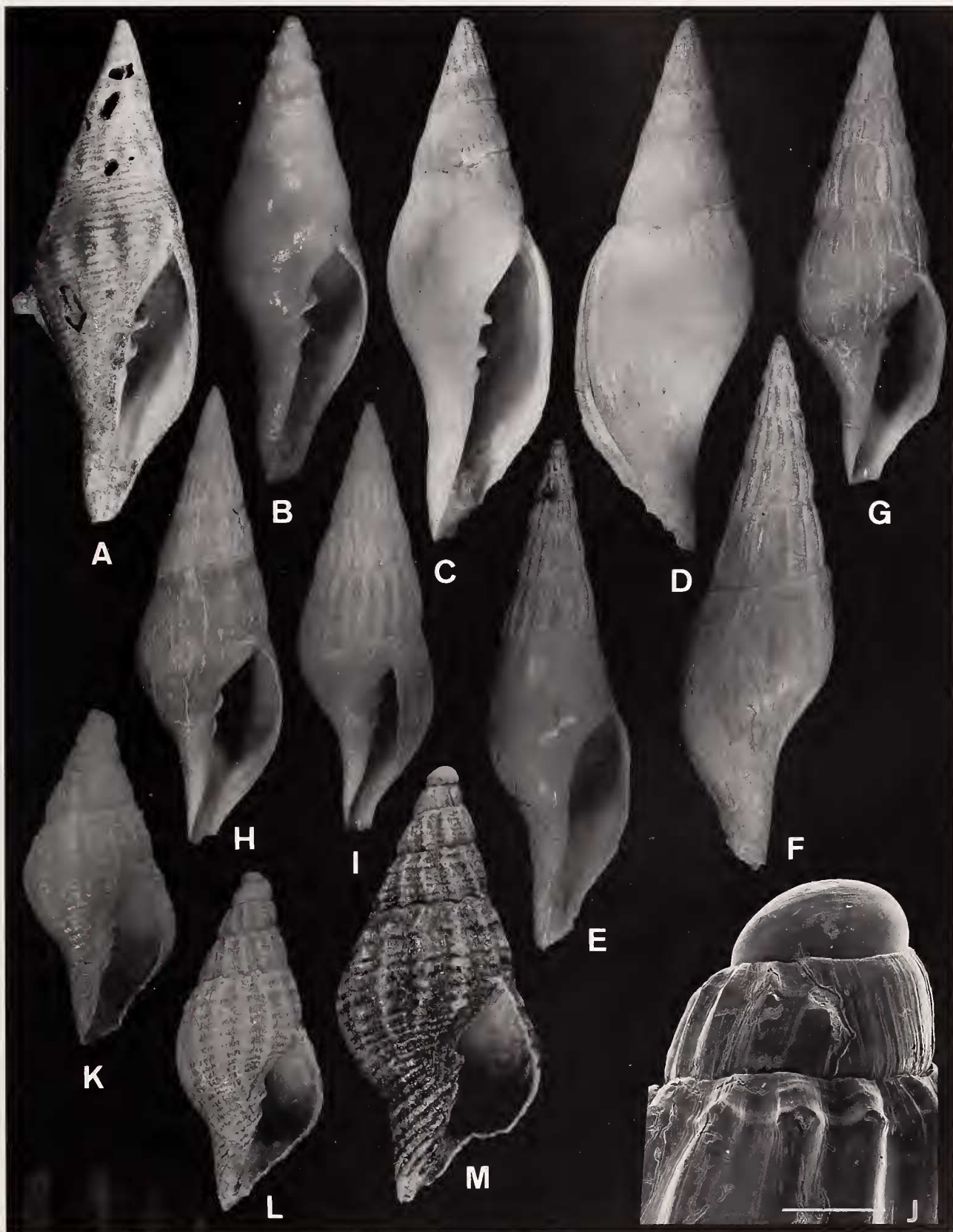
Distribution: Gulf of Mexico and Caribbean Sea, in 400–730 m (dead collected) (Figure 10).

Diagnosis: Protoconch paucispiral, 1.3 whorl, diameter 875 µm. First three teleoconch whorls with strong, broad,

→

Figure 6

Latiromitra aratiuncula (A). A. Holotype (USNM 784594, shell height 20.0 mm). *Latiromitra meekiana* (B–D). B. Lectotype (USNM 86970, shell height 15.2 mm). C, D. Caribbean Sea (R/V *John Elliott Pillsbury*, sta. 1225, shell height 26.0 mm, UMML 30.8260—radula and operculum illustrated by Bayer, 1971, figs. 55, D–E). *Latiromitra barthelowi* (E–J). E, F. Holotype (USNM 238444, shell height 27.4 mm). G. Indonesia, Tanimbar Islands (KARUBAR, sta. CC41, shell height 52.0 mm—anatomy see Figure 2A). H. Indonesia, Tanimbar Islands (KARUBAR, sta. CC72, shell height 48.7 mm—radula see Figure 3D–F). I. Indonesia, Tanimbar Islands (KARUBAR, sta. CP59, shell height 38.2 mm), shell turned to show the columellar plaits. J. Protoconch (KARUBAR, sta. CP70, scale bar 500 µm). ?*Latiromitra styliola* (K–M). K. Lectotype (USNM 108440, shell height 6.5 mm). L. Paralectotype (USNM 880282, shell height 6.6 mm). M. Paralectotype (USNM 880282, shell height 8.5 mm).



axial ribs, 10 per whorl, subsequent whorls smooth; three ill-defined spiral cords in subsutural zone, cord at shoulder stronger, intersection with axial ribs angular. Columellar folds 3. Color white. Maximum dimensions 26.0 mm.

Remarks: *L. meekiana* differs from *L. cryptodon* by its paucispiral protoconch, last teleoconch whorl without axial sculpture, and proportionally higher aperture (63% of total shell height vs. 51% in *cryptodon*).

Latiromitra aratiuncula (Quinn, 1981) **comb. nov.**
(Figures 6A, 10)

Cyomesus aratiunculus Quinn, 1981:75, fig. 4.

Type material: Holotype USNM 784594.

Type locality: Off Virgin Islands, 18°26.4'N, 63°12.6'W, 430 m [R/V *John Elliott Pillsbury*, sta. P-984].

Material examined: The holotype.

Distribution: Off Virgin Islands, 430 m (dead collected) (Figure 10).

Diagnosis: A slender, coarsely sculptured *Latiromitra* species, height/diameter 3.1, last whorl occupying 66% of total shell height. Sculpture consisting of strong axial ribs, axial extension restricted to whorl periphery, 13 on penultimate whorl, fading out in last part of last whorl; raised spiral cords, with narrower interspaces, covering whole exposed height of whorls, nine on antepenultimate and penultimate whorls, 41 on last adult whorl extending onto base and canal. Siphonal canal long. Columellar folds 3. Color probably white. Maximum dimensions (holotype) 20.0 mm, diameter 9.3 mm.

Remarks: The holotype and only known specimen is worn and imperfect. The protoconch is unknown, and the early teleoconch whorls are very worn. However, *L. aratiuncula* is a very distinctive species, the only one with ribs restricted to short axial extensions near whorl periphery, and spiral cords covering whole whorl height.

?*Latiromitra styliola* (Dall, 1927) **comb. nov.**
(Figures 6K–M, 10)

Mitra styliola Dall, 1927:48.

Other references:

Costellaria styliola: Kaicher, 1974: card 266.

Type material: Lectotype (designated by Kaicher, 1974) USNM 108440 and 10 paralectotypes USNM 880282.

Type locality: Off Georgia, 30°44'N, 79°26'W [R/V *Albatross*, sta. 2415]. In the original description, the depth is given as 440 fathoms and 948 meters, which do not match each other (440 fms = 805 m).

Material examined: The lectotype and paralectotypes.

Distribution: Off Georgia, southeastern United States (Figure 10).

Diagnosis: A small, coarsely sculptured *Latiromitra* species, height/diameter 2.05–2.21, last whorl occupying 68–69% of total shell height. Protoconch paucispiral, consisting of 1.5 smooth whorls, protoconch/teleoconch discontinuity sharp. Sculpture consisting of strong axial ribs, reaching shell base, 12 on penultimate whorl, 13 on the last whorl (of 8.5 mm high paralectotype); raised spiral cords, with narrower interspaces, covering whole exposed height of whorls, six on antepenultimate and penultimate whorls, 20 on last adult whorl (of 8.5 mm high paralectotype) extending onto base and canal. Siphonal canal moderately long. Columellar folds 3. Color white. Maximum dimensions (paralectotype) 10.3 mm.

Remarks: The lectotype and all paralectotypes are dead and worn young specimens that bear a general resemblance to species such as *L. aratiuncula* and *L. cryptodon*. In particular, the stronger spiral cord in the adapical third of the exposed whorl height and the fine, even basal cords on the last whorl appear to suggest a position in *Latiromitra* rather than in *Mitroidea*. However, the lack of preserved material and even adult shells does not allow us to draw firm conclusions, and we do not exclude the possibility that the species actually belongs to the family Costellariidae as suggested by Kaicher (1974). *Mitra styliola* has been illustrated only once before, by Kaicher (1974: card 266) who figured one of the 11 syntypes as “the type”, which constitutes a lectotype designation under article 74b of the Code of Nomenclature. An application to place Kaicher’s work on the Official Index of Rejected Works has been rejected by the International Commission on Zoological Nomenclature (Opinion 1905).

Latiromitra barthelowi (Bartsch, 1942)
(Figures 2A–C, 6E–J, 11)

Prodallia barthelowi Bartsch, 1942:12, 13, pl. 2, fig. 2.

Other references:

Teramachia barthelowi: Weaver & DuPont, 1970:177, pl. 75C, D (holotype illustrated); Bayer, 1971:196–198; Bouchet & Poppe, 1995:504.

Benthovoluta barthelowi: Rehder, 1972:7; Cernohorsky, 1973:127.

Cyomesus barthelowi: Quinn, 1981:76, fig. 5 (holotype illustrated).

Latiromitra barthelowi: Bouchet & Warén, 1985:255, fig. 390.

Type material: Holotype USNM 238444.

Type locality: Philippines, Sulu Sea, off Cagayan Island, 09°37'45"N, 121°11'E, 905 m [R/V *Albatross*, sta. 5425].

Material examined: The type material.

INDONESIA, TANIMBAR ISLANDS. KARUBAR: R/V *Baruna Jaya* 1, sta. CP39, 08°36'S, 131°33'E, 466–

477 m, 1 lv.—Sta. CC41, 07°45'S, 132°42'E, 401–393 m, 1 lv.—Sta. CC56, 08°16'S, 131°59'E, 552–549 m, 2 lv, 1 dd.—Sta. CP59, 08°20'S, 132°11'E, 405–399 m, 4 lv, 2 dd.—Sta. CP69, 08°42'S, 131°53'E, 356–368 m, 1 dd.—Sta. CP70, 08°41'S, 131°47'E, 413–410 m, 1 lv.—Sta. CP71, 08°38'S, 131°44'E, 477–480 m, 1 juv. lv.—Sta. CP72, 08°36'S, 131°33'E, 699–676 m, 2 lv.—Sta. CP75, 08°46'S, 131°36'E, 452–451 m, 2 lv.—Sta. CP91, 08°44'S, 131°05'E, 884–891 m, 1 dd.

INDONESIA, KAI ISLANDS. KARUBAR: R/V *Ba-runa Jaya 1*, sta. CC21, 05°14'S, 133°00'E, 688–694 m, 1 dd.

PHILIPPINES. MUSORSTOM 2: R/V *Coriolis*, sta. CP79, 13°44'N, 120°32'E, 682–770 m, 1 lv.—MUSORSTOM 3: R/V *Coriolis*, sta. CP122, 12°20'N, 121°42'E, 673–675 m, 1 dd. (all MNHN).

Distribution: Philippines and eastern Indonesia, alive in 401–682 m (Figure 11).

Diagnosis: A large *Latiromitra*, height/diameter 2.7–3.0 (adults) to 2.95–3.1 (subadults), last whorl occupying 60–68% (average 62%, $n = 7$) of total shell height, 52.0 mm high at 8.0 teleoconch whorls. Protoconch (Figure 6J) paucispiral, of 1–1.3 smooth whorls, diameter 1100–1150 μm . First five teleoconch whorls with 14–18 strong rounded axial ribs, interspaces narrower than ribs, subsequent whorls generally smooth, but axial ribs occasionally persistent until seventh whorl. Spiral sculpture with shoulder cord, defined by its abapical margin, usually distinct on first three to five whorls, but sometimes obsolete; last whorl occasionally with a few low, indistinct narrow cords, but usually smooth; eight to 12 broad cords on base and canal, interspaces much narrower than cords. Siphonal canal rather short. Columellar folds 3, abapical one very weak, sometimes indistinct. Color white, columellar region pinkish, with rather thick, opaque, olive-brown periostracum. Maximum dimensions 52.0 mm, diameter 17.7 mm.

Remarks: Despite its small size (height 27.4 mm), the holotype from the Philippines appears to be adult, based on its slightly flaring outer lip. It is considerably narrower ($h/d = 3.4$) than any other specimen, and its high, broad, flat-topped axial ribs are not shouldered by a spiral cord. It contrasts with the Indonesian material, which is rather homogeneous but comes from a restricted geographical area. The MUSORSTOM specimens from the Philippines have rather intermediate characters, and therefore we believe that all the material examined is conspecific.

Latiromitra paiciorum Bouchet & Kantor, sp. nov.

(Figures 7 A–C, 11)

Type material: Holotype and three paratypes in MNHN.

Type locality: New Caledonia, off Cape Bayes, 21°05'S, 165°50'E, 960–1100 m [BATHUS 1, sta. CP661].

Material examined: NEW CALEDONIA. BATHUS 1: R/V *Alis*, sta. CP661, 21°05'S, 165°50'E, 960–1100 m, 1 lv, 3 dd (holotype, three paratypes).

BIOCAL: R/V *Jean-Charcot*, sta. CP61, 24°11'S, 167°32'E, 1070 m, 1 dd.

Distribution: New Caledonia and Norfolk Ridge (Figure 11).

Description (adult holotype): Shell slender, fusiform, solid, consisting of 2+ protoconch and 7.5 teleoconch whorls. Protoconch I and initial part of protoconch II missing, remaining part of protoconch II broadly conical, with smooth, moderately convex whorls, a few opisthocyrt axial ribs before the sharp protoconch/teleoconch boundary. Teleoconch whorls convex, slightly concavely depressed in subsutural ramp of last two whorls, suture impressed. Sculpture predominantly axial, consisting of solid orthoconch ribs, 10 on first whorl, nine on whorls 2–3, increasing to 12 on penultimate whorl, ribs generally connected axially to those of preceding and successive whorls, on last adult whorl forming only weakly defined undulations. One much weaker but distinct spiral cord situated at about one-third of exposed whorl height below adapical suture, its adapical margin indistinct, abapical margin abruptly elevated, forming asymmetrical bead at intersection with axial ribs; other spiral cords much more weakly defined, one or two in subsutural ramp, two or three below main cord. On penultimate whorl, the shoulder cord becomes less sharply defined and there are nine equally weak spiral cords; on last whorl, these spiral cords are still more weakly defined, more broadly spaced near periphery, and there are 25 well-defined, evenly spaced cords on base and canal, interspaces narrower than cords. Aperture narrow, ovoid, elongate, less than 50% of total shell height. Outer lip thin, straight, regularly convex, inner lip with a thin opaque callus over parietal area. Siphonal canal broad, short. Columella with three strong plaits, adapical one stronger. Color light brown-beige, polished, periostracum transparent. Protoconch brown.

Dimensions of holotype (the largest specimen known): shell height 25.1 mm, last teleoconch whorl height 14.6 mm, aperture height 10.0 mm, siphonal canal height 2.4 mm, shell diameter 8.7 mm.

Remarks: The better preserved protoconch of a paratype has 3.2 whorls (Figure 7C), but the initial part (probably only the nucleus of protoconch I) is missing. It has a sculpture of one strong subsutural cord, and there are about eight opisthocyrt axial ribs before the protoconch/teleoconch boundary, more closely set just before the end of the protoconch. The teleoconch sculpture of the paratypes differs from that of the holotype in that the axial ribs extend onto the last whorl.

Latiromitra paiciorum resembles *L. cryptodon* in general appearance, but differs in having fewer axial ribs (10–14 vs. 18–24 on last adult whorl), stronger columel-

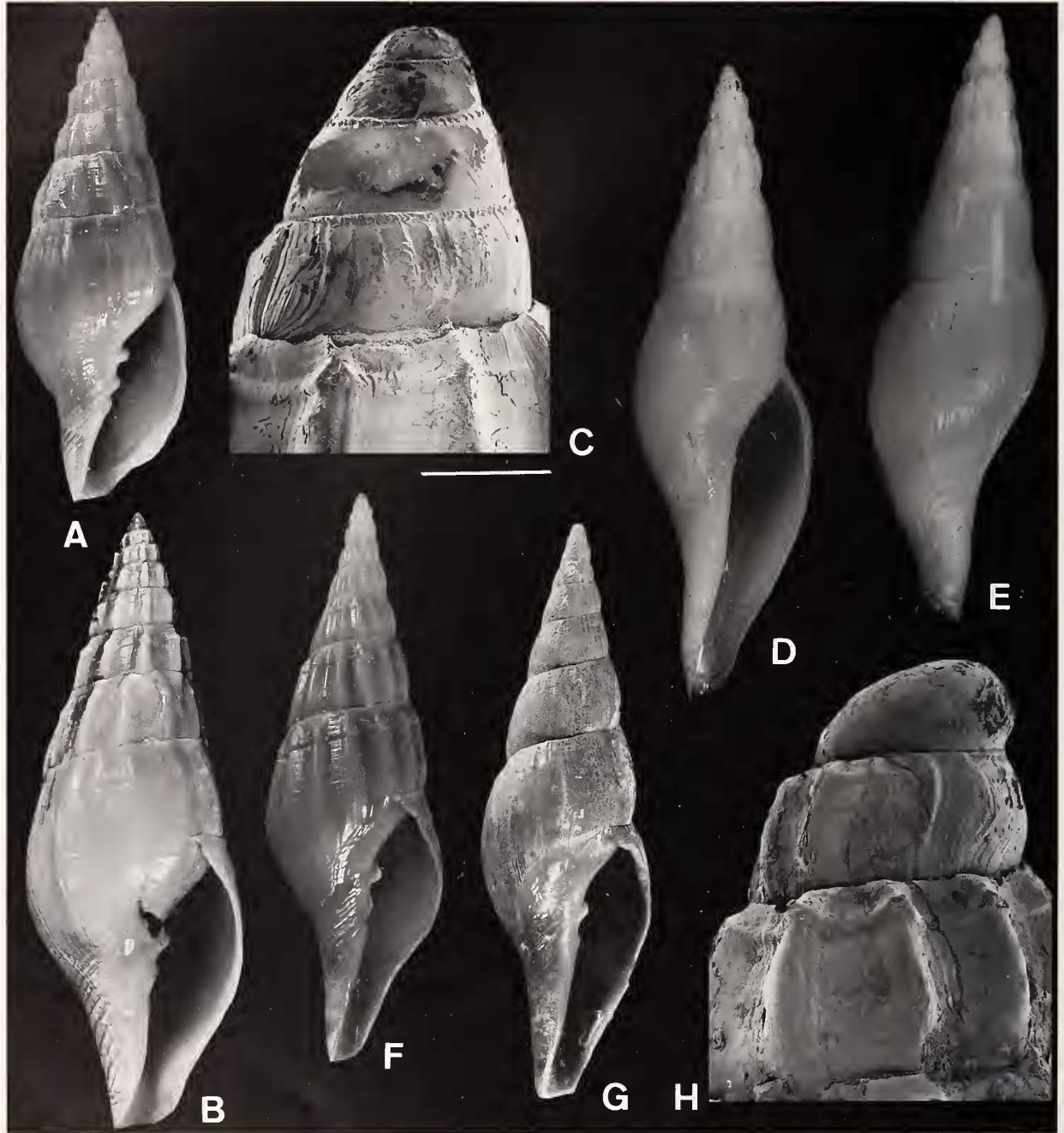


Figure 7

Latiromitra paiciorum Bouchet & Kantor, sp. nov. (A–C). A. Holotype (MNHN, shell height 25.1 mm). B. Paratype (MNHN, shell height 24.6 mm). C. Protoconch (same specimen as B, scale bar 500 µm). *Latiromitra delicatula* (D, E, southwest of Taiwan, MNHN, shell height 33.3 mm). *Latiromitra cacozeliana* Bouchet & Kantor, sp. nov. (F–H). F. Holotype (MNHN, shell height 33.3 mm). G. Paratype (off Epi, MUSORSTOM 8, sta. CP1051, shell height 59.5 mm). H. Protoconch (paratype, off Erromango, MUSORSTOM 8, sta. CP992; same magnification as C).

lar plaits, and a more multispiral protoconch (3.2 vs. 2.5 whorls). It differs from other Indo-Pacific species by its small adult size and multispiral protoconch.

Etymology: Named after the Kanak linguistic group occupying the east coast of New Caledonia near Cape Bayes (the type locality), speakers of the Paici language.

Latiromitra cacozeliana Bouchet & Kantor, sp. nov.

(Figures 7F–H, 11)

Type material: Holotype and two paratypes in MNHN.

Type locality: Vanuatu [formerly New Hebrides], off Tanna Island, 19°24'S, 169°29'E, 536–556 m [MUSORSTOM 8, sta. CP975].

Material examined: VANUATU. MUSORSTOM 8: R/V *Alis*, sta. CP975, 19°24'S, 169°29'E, 536–556 m, 1 dd (holotype).—Off Erromango, Sta. CP992, 18°52'S, 168°55'E, 748–775 m, 1 dd (paratype; protoconch photographed).—Off Epi, Sta. CP1051, 16°37'S, 168°00'E, 555–558 m, 1 dd (paratype).

Distribution: Vanuatu archipelago, 536–775 m (dead) (Figure 11).

Description (subadult holotype): Shell slender, fusiform, solid, consisting of 1.3 protoconch and eight teleoconch whorls. Protoconch light brown, diameter 825 µm, with large nucleus, subsequent whorl very convex, smooth, with four moderately opisthocyrt axial ribs before the sharp protoconch/teleoconch boundary. Teleoconch whorls rather flat, suture shallow, moderately adpressed. Sculpture predominantly axial, consisting of broad, solid, orthocone ribs, interspaces slightly narrower than ribs, 11 on first whorl, 10 on whorls 2–3, increasing to 13 on penultimate whorl, ribs not connected axially to those of preceding and successive whorls, on last part of last whorl becoming less well defined. One spiral cord situated at about one-fourth of exposed whorl height below adapical suture, its adapical margin indistinct, abapical margin abruptly elevated, forming asymmetrical bead at intersection with axial ribs; another narrow spiral thread below periphery, indistinct on spire whorls, well defined on last two whorls. Last whorl with 15 axial ribs, two or three ill-defined cords in subsutural ramp, and 25 cords on base and canal, weak and low at level of parietal region, raised and distinct at level of columella, interspaces much narrower than cords. In addition, there are very fine incremental lines and extremely fine spiral striae, best seen with oblique light. Aperture narrow, ovoid, elongate, less than 50% of total shell height. Outer lip (chipped) thin, straight, regularly convex, inner lip with a thin transparent callus over parietal area. Siphonal canal broad, moderately long, rather distinctly set off from aperture. Columella with three strong plaits, adapical one stronger, abapical one only weakly indicated. Color light

chocolate brown, lighter on apical whorls, protoconch light brown.

Dimensions: height 33.3 mm, diameter 10.5 mm, last whorl height 20.0 mm, aperture height 11.0 mm, siphonal canal height 4.0 mm.

Remarks: The largest paratype reaches 59.5 × 18 mm (last whorl height 37.3 mm, aperture height 19.2 mm, siphonal canal height 8.0 mm). The tip of the spire is broken, and the sculpture of the first few whorls is rather worn, but they appear to have essentially the characters of the holotype. On the penultimate and antepenultimate whorls the axial ribs fade out and do not reach the abapical suture, and on the last whorl there are only vague undulations that are reminiscent of the axial sculpture.

Latiromitra cacozeliana is a very distinctive species, characterized by its slender (h/d = 3.2–3.3), solid, chocolate brown shell, large adult size, and rather long siphonal canal. The morphology of the protoconch, which indicates non-planktotrophic lecithotrophic larval development, probably with short dispersal stage, also differs from that of its congeners.

Etymology: After the Greek *cacozelia*, meaning a vicious imitation, an allusion to the superficial similarity to species of *Benthovoluta*.

Latiromitra crosnieri Bouchet & Kantor, sp. nov.

(Figures 4A–C, 8A–E, 12)

Type material: Holotype and three paratypes in MNHN.

Type locality: Off NW Madagascar, 12°49'S, 48°27'E, 925–975 m [R/V *Vauban*, chalutage 118].

Material examined: MADAGASCAR. R/V *Vauban*, chalutage 22, 12°27'S, 48°10'E, 700–680 m, three lv (paratypes).—Chalutage 118, 12°49'S, 48°27'E, 925–975 m, 1dd (holotype). SW PACIFIC. R/V *Alis*, MUSORSTOM 7, sta. DW540, 12°27'S, 177°28'W, 600 m, 1 lv.—Sta. CP552, 12°16'S, 177°28'W, 786–800 m, 1 lv.

Distribution: Madagascar and NE of Fiji, 600–800 m (live) (Figure 12).

Description (holotype): Shell slender, fusiform, solid, consisting of 1.2 protoconch and eight teleoconch whorls. Protoconch paucispiral, with large initial nucleus, indicating non-planktotrophic larval development, diameter 950 µm, protoconch/teleoconch boundary sharp. First three teleoconch whorls convex, subsequent whorls rather flat-sided, suture impressed, slightly channelled. First five whorls with strong axial sculpture, consisting of solid orthocone ribs, 10, 13, 15 on second, third, and fourth whorl, respectively, interspaces as broad as ribs. On the fifth whorl, the ribs fade out, and subsequent whorls are smooth with closely set incremental lines. Axial ribs intersected by a weakly marked, broad spiral cord, that is defined by its sharp abapical margin and situated at about

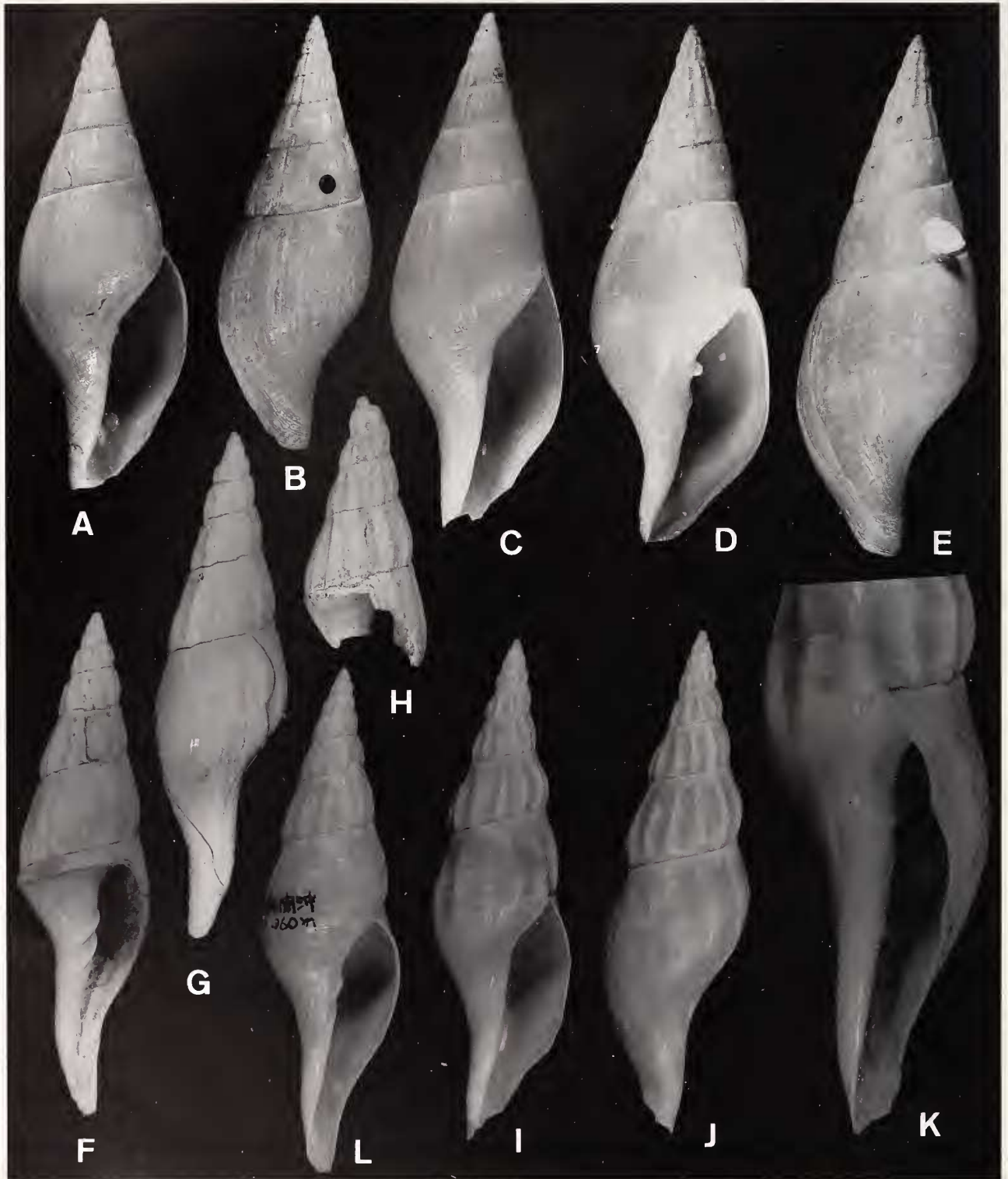


Figure 8

Latiromitra crosnieri Bouchet & Kantor, sp. nov. (A–E). A, B. Holotype (MNHN, shell height 41.2 mm). C. Paratype, Madagascar (R/V *Vauban*, chalutage 22, shell height 30.4 mm—radula see Figure 4 A–C). D, E. NE of Fiji (MUSORSTOM 7, sta. DW540, shell height 49.0 mm). *Latiromitra okinavensis* (F–L). F, G. Holotype, USNM

one-third of exposed whorl height below adapical suture. Spiral cord obsolete on last smooth whorls. Last adult whorl smooth above periphery, below periphery sculptured by ca. 25 low, broad cords, stronger toward base and canal, interspaces narrower than cords. Aperture rather broad, ovoid, elongate, about 50% of total shell height. Outer lip thin, straight, regularly convex, inner lip with a thin opaque callus over parietal area. Siphonal canal broad, short. Columella with three strong plaits, adapical one stronger. Color of protoconch and early whorls white, gradually darkening to light creamy beige toward adult whorls, periostracum transparent.

Dimensions: height 41.2 mm, aperture height 21.0 mm, diameter 14.7 mm.

Remarks: *Latiromitra crosnieri* shares with *L. barthelemi*, *L. delicatula*, and *L. okinavensis* the morphology of the protoconch and early teleoconch whorls. It differs by the combination of broad outline (height/diameter 2.6–2.8 vs. 3.18–3.6), high aperture, and numerous, closely set axial ribs on early teleoconch whorls.

Etymology: Named after Alain Crosnier, then of Centre ORSTOM de Nossi-Bé, who collected the type material in 1972–74 during surveys of shrimp stocks off the coast of Madagascar.

Latiromitra delicatula (Shikama, 1971) **comb. nov.**

(Figures 7D, E, 12)

Benthovoluta delicatula Shikama, 1971:32, pl. 3, figs. 17–20.

Other references:

Benthovoluta delicatula: Habe, 1976:97, pl. I, fig. 2; Matsukuma, Okutani & Habe, 1991:178, pl. 59, figs. 12, 13.

Type material: Holotype said to be in the Geological Institute, Yokoyama National University (not seen).

Type locality: South China Sea, depth unknown.

Material examined: Southwest of Taiwan, 1 dd (MNHN ex coll. Poppe).

Distribution: Known from South China Sea and off Taiwan (Figure 12).

Diagnosis: A slender, narrow *Latiromitra* species, height/diameter 3.3–3.6, last whorl occupying 68% of total shell height, 33.2 mm high at 6.5 teleoconch whorls. Protoconch paucispiral, of 1.3 smooth whorls, diameter 950 μ m. Eleven strong axial ribs on first four teleoconch whorls, fading out on subsequent whorls, last adult whorl

smooth. Spiral sculpture with one well-defined shoulder cord and four to six additional, very weakly defined cords on first four spire whorls, only abapical margin of shoulder cord perceptible on subsequent whorls; about 12 cords on base and canal. Siphonal canal long. Columellar folds 2, deep inside aperture. Color white. Maximum dimensions (holotype) 43.8 mm, diameter 12.3 mm.

Latiromitra okinavensis (MacNeil, 1961)

comb. nov.

(Figures 4D–F; 8F–H, 12)

Benthovoluta okinavensis MacNeil, 1961:96, pl. 9, figs. 2, 3.

Synonyms:

Benthovoluta sakashitai Habe, 1976:97–99, pl. I, fig. 3. (**syn. nov.**)

Other references:

Okinawavoluta okinavensis: Noda, 1980:33, 34, pl. 7, figs. 16a, b, pl. 10, figs. 20a, b, pl. 11, fig. 8; Noda, 1988: 48, pl. 11, figs. 2a–3b.

Type material: *B. okinavensis*: holotype USNM [Dept of Paleobiology] 562841. *B. sakashitai*: holotype NSMT-Mo 52579, two paratypes NSMT-Mo 52580, 52581, all live taken.

Type locality: *B. okinavensis*: Okinawa, Chinzato Formation (Pliocene). *B. sakashitai*: southern Japan, Kyushu, off Makurazaki, Kagoshima Prefecture, 350–360 m.

Material examined: The type material.

OKINAWA, Chinzato formation, 1 fragment (USNM 353596).

Distribution: Okinawa, Pliocene; Kyushu, Recent, 350–360 m (alive) (Figure 12).

Diagnosis: A slender, narrow *Latiromitra* species, height/diameter 3.18–3.86, last whorl occupying 64–68% of total shell height, 47.5 mm high at 7.5 teleoconch whorls. Protoconch paucispiral, of 1.2–1.3 smooth whorls, diameter 1000 μ m. 10–11 strong axial ribs on first teleoconch whorls, increasing to 13 on penultimate whorl, fading out on last whorl. Spiral sculpture with one broad shoulder cord, especially strong and well defined on first four whorls, and additional, weakly defined cords; all cords thin, rather indistinct and equal on last two whorls, ca. eight to 10 on penultimate whorl; about 12 cords on base and canal. Siphonal canal long. Columellar folds 2, deep inside aperture. Color brownish flesh. Maximum dimensions (holotype of *B. sakashitai*) 47.5 mm, diameter 14.0 mm.

←

562841, shell height 47.2 mm. H. Fragment of the shell, Okinawa, Chinzato Formation (Pliocene), height of the remaining part 14.6 mm. I–K. holotype of *Benthovoluta sakashitai* Habe, 1976 (NSMT-Mo 52579, shell height 47.5 mm). L. paratype of *B. sakashitai* (NSMT-Mo 52581, shell height 47.2 mm—radula see Figure 4D–F).

Remarks: Comparison of the holotype and published illustrations of *Latiromitra okinavensis* (Noda, 1980, 1988) with the types, and only known material, of *Benthovoluta sakashitai* demonstrates their conspecificity. *Latiromitra okinavensis* is distinguished from its congeners by its slender shell with higher last whorl. The most similar Pacific species is *Latiromitra barthelowi*, which differs in having a less slender shell and more numerous axial ribs.

The genus *Okinawavoluta* was established for this single species. Noda (1980) compared it with *Benthovoluta*, *Latiromitra* being then virtually unused. The shell morphology leaves no doubt of it being congeneric with the Recent species placed by us in *Latiromitra*.

Latiromitra vitilevensis (Ladd, 1982) **comb. nov.**

(Figures 9, 12)

Volutomitra? vitilevensis Ladd, 1982:56, pl. 14, figs 8, 9.

Type material: Holotype USNM [Dept of Paleobiology] 214332.

Type locality: Viti Levu, Fiji Is, US Geological Survey station C2026, "From bulldozed surface thought to be close to dip slope between C2021 [West of pumping station Nausori] and C2024 [roadcut west of C2021]," 18°02.0'S, 178°31.3'E, Pliocene.

Material examined: The holotype.

Distribution: Only known from Viti Levu, Fiji; Pliocene (Figure 12).

Diagnosis: Shell slender, fusiform, height/diameter 2.90, last whorl occupying 67% of total shell height, consisting of 7.8 teleoconch whorls. Protoconch with only last whorl remaining (probably 0.5+ whorl broken), smooth, with a few opisthocyrt axial riblets before protoconch/teleoconch discontinuity, diameter 775 μ m. Ten strong axial ribs on first teleoconch whorls, increasing to 14 on penultimate whorl, fading out on last whorl. Spiral sculpture with one broad shoulder cord, remaining strong and well defined onto last whorl, and additional, weaker and uneven, but well-defined cords, becoming obsolete abapically on penultimate whorl and on periphery of last whorl; ca. eight on penultimate whorl, four adapically, four abapically of shoulder cord; about 25 cords on base and canal. Siphonal canal long. Columellar folds 3, well exposed due to chipped aperture. Dimensions: height 34.5 mm, diameter 11.9 mm.

Remarks: The rather flat teleoconch whorls with strong axial ribs and distinct spiral cord on the shoulder are characters shared with species of *Ceratoxancus* and *Latiromitra*, but not with those of *Volutomitra*. *V. vitilevensis* does not have the labral tooth or groove that is found in several species of *Ceratoxancus*, including the type species, and in this respect is similar to the type and other species of *Latiromitra*. Based on these shell characters,



Figure 9

Latiromitra vitilevensis. Holotype USNM 214332, shell height 34.5 mm.

we here transfer *Volutomitra? vitilevensis* to the genus *Latiromitra*. In the original description, Ladd (1982) noted the "somewhat obscure" family and generic relations. *L. vitilevensis* shows overall resemblance to *L. cryptodon*, from which it differs by having fewer axial ribs. What remains of the broken protoconch suggests that the species had non-planktotrophic larval development; however, the presence of opisthocyrt axial riblets before the protoconch/teleoconch boundary may be correlated with a short lecithotrophic dispersal stage.

The associated fauna at the type locality indicates a moderately deep-water assemblage. For instance, *Pseu-*

Table 1
Conchological and radular characters discriminating the species of *Latiromitra*.

	<i>aratiuncula</i>	<i>barthelowi</i>	<i>cacozeli-ana</i>	<i>croisneri</i>	<i>cryptodon</i>	<i>delicatula</i>	<i>meeikiana</i>	<i>paiciorum</i>	<i>okinavensis</i>	<i>styliola</i>	<i>vitilevensis</i>
Maximum adult size (mm)	20.0	52.0	59.5	41.2	55.0	43.8	26.0	25.1	47.5	>10.3	34.5
Number of protoconch whorls	n.a.	1.3	1.3	1.2	2.5	1.3	1.3	3.2	1.3	1.5	≈1.5
Maximum diameter of protoconch (µm)	n.a.	1150	825	950	1320	950	875	1125	1000	900	775
Sculpture on the last adult whorl	axial ribs + spiral cords	broad spiral cords on the base	smooth	broad spiral cords	axial ribs + spiral cords	spiral cords on the base	smooth	axial ribs + spiral cords	axial ribs + spiral cords	axial ribs + spiral cords	obsolete axial ribs + spiral cords
Operculum length/aperture height	n.a.	0.3	n.a.	0.3	0.40–0.75	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Radula width/aperture height, %	n.a.	1.4	n.a.	0.92	1.39	n.a.	n.a.	n.a.	1.35	n.a.	n.a.
Radula length/aperture height, %	n.a.	28	n.a.	17	20	n.a.	n.a.	n.a.	17.5	n.a.	n.a.
Number of rows of radular teeth	n.a.	130	n.a.	105	80	n.a.	n.a.	n.a.	110	n.a.	n.a.

domalaxis roddai Ladd, 1982, described from the same fossil locality, has subsequently been synonymized by Bieler (1993:322) with *Spirolaxis rotulacatharinae* (Melvill & Standen, 1903), which is recorded alive at depths of 146–302 m.

DISCUSSION

Anatomy

In comparative remarks on the anatomy of *Ceratoxancus*, Kantor & Bouchet (1997) enumerated the characters that are shared by *Latiromitra*, *Ceratoxancus*, and *Benthovoluta*: (1) short or very short proboscis, (2) paired proboscis retractors, (3) position of the buccal mass and opening of the radular diverticulum into the buccal cavity at the proboscis base in its contracted position, (4) ventral odontophore retractor passing through the nerve ring, (5) presence of a single accessory salivary gland, (6) large gland of Leiblein, (7) mid-esophagus with well-developed dorsal glandular folds, and (8) small stomach.

The general anatomy of studied species of *Latiromitra* is very similar to that of *Ceratoxancus*. The only significant difference is that in *Latiromitra* the salivary glands are fused, while in *Ceratoxancus* the glands are clearly separate.

Mode of Development

Planktotrophic larval development can be inferred from the multispiral protoconch of *L. cryptodon* and *L. paiciorum*. This is correlated with the broad, disjunct distribution of *L. cryptodon*, which lives on both sides of the Atlantic and on the mid-Atlantic Ridge, separated from each other by abyssal depths. The protoconch of *L. paiciorum* suggests that it has a wider range than the two stations off New Caledonia currently indicate. Non-planktotrophic larval development can be inferred from the paucispiral protoconch of *L. meeikiana*, *?L. styliola*, *L. barthelowi*, *L. cacozeliana*, *L. croisneri*, *L. delicatula*, and *L. okinavensis*. The protoconch is partly broken in the only known specimen of *L. vitilevensis*, and what remains suggests that the species had non-planktotrophic larval development. Non-planktotrophy is rather unexpected in *L. croisneri*, which is known from two widely separated localities, off Madagascar and NE of Fiji. This suggests that it may be found at many intermediate localities and/or that its lecithotrophic larva has a free-swimming demersal phase. The protoconch is unknown in *L. aratiuncula*.

Composition of the Genus

The radular morphology of *Latiromitra cryptodon* (Table 1) appears to be very similar to that of *Fasciolaria meeikiana* Dall, 1889, the type species of *Cyomesus* Quinn, 1981. The radula illustrated by Bayer (1971: fig. 55B, D, as *Teramachia chaunax*) has a multicuspoid rach-

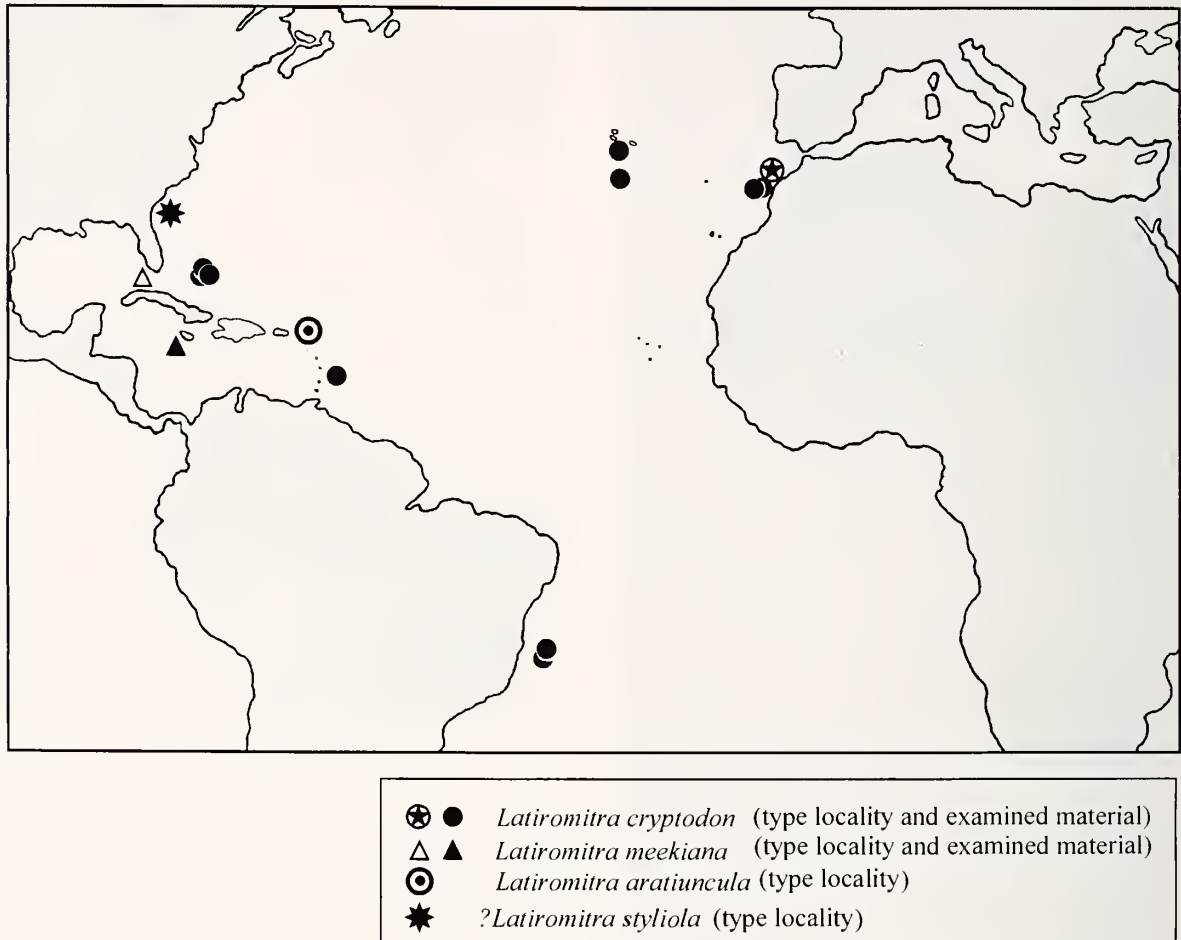


Figure 10

Distribution of the Atlantic species of *Latiromitra*.

idian, with three cusps on both sides of the larger central cusp, whereas in another specimen the radula has a normal three-cusped rachidian (Harasewych, 1987). Thus this character seems to be intraspecifically variable or, more likely, the radula illustrated by Bayer may have had a number of teratological radular rows. The radulae of *L. barthelowi*, *L. okinavensis*, and *L. crosnieri* are also similar to that of *L. cryptodon*, both in terms of teeth shape and relative dimensions. It should be mentioned that the radula of *L. crosnieri* is intermediate in terms of rachidian shape between *L. cryptodon* on the one hand, and *L. barthelowi* and *L. okinavensis* on the other. At the same time, the radula of *L. crosnieri* is significantly narrower than that of other studied species.

The shell of *Latiromitra cryptodon* is very similar to the shell of the type species of *Cyomesus*, as well as other species originally included by Quinn (1981) in *Cyomesus*: *Teramachia chaunax*, *Cyomesus aratiunculus*, and *Prodallia barthelowi*. These shells are characterized by hav-

ing a sculpture with strong axial ribs and flattened and evenly convex teleoconch whorls. Therefore there seems to be no reason to consider *Cyomesus* distinct from *Latiromitra*, and we confirm the synonymy established by Bouchet & Warén (1985).

In addition to the species already discussed, *Benthovoluta delicatula* Shikama, 1971, and *B. okinavensis* MacNeil, 1961, from off Taiwan and Japan respectively, are conchologically similar and should be included in *Latiromitra*, as suggested by Harasewych (1987) [as *Cyomesus*] (the latter species under the name *B. sakashitai*). The radula is known only for *L. okinavensis*, and in all details it is similar to that of other species studied. The same applies for *Volutomitra? vitilevensis* Ladd, 1982, which is here included in *Latiromitra*.

Latiromitra species differ from *Ceratoxancus* in having narrower, more lightly built shells, with predominantly axial sculpture, and spiral cords generally limited to the shoulder of the apical whorls and the base of the last

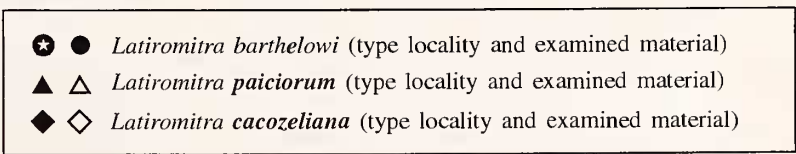
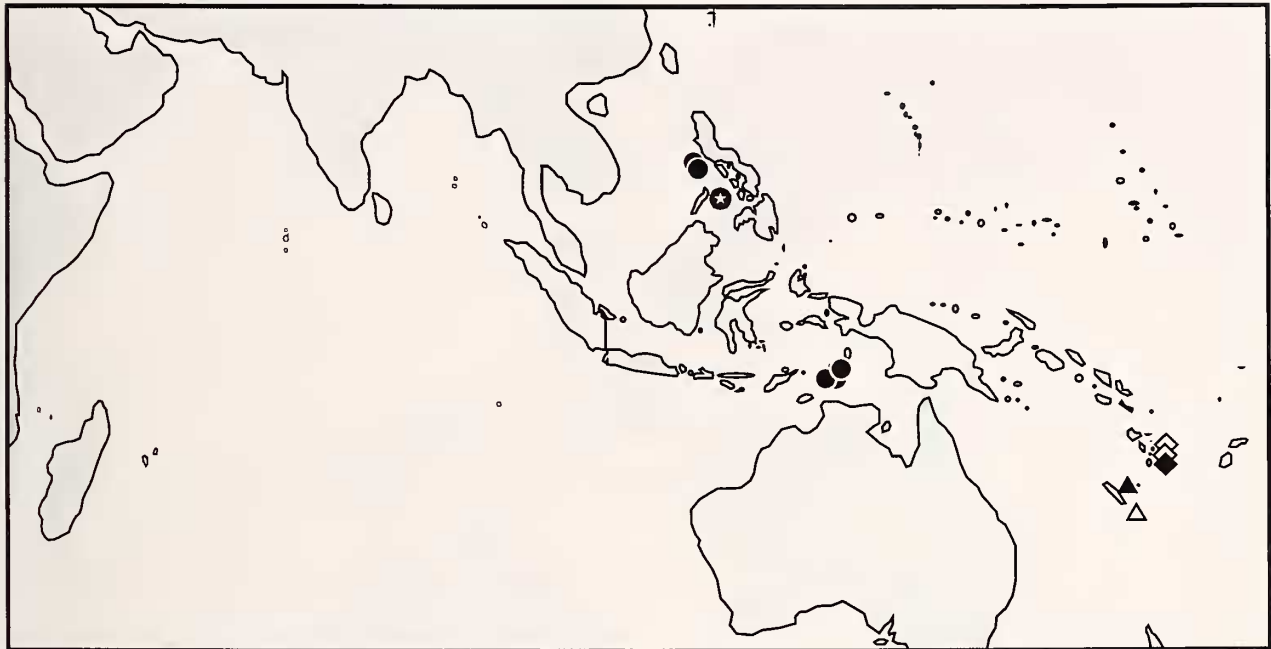


Figure 11

Distribution of *Latiromitra barthelowi*, *L. paiciorum* Bouchet & Kantor, sp. nov., and *L. cacozeliana*. Bouchet & Kantor, sp. nov.

whorl. They also lack a labral spine or fasciole. However, in view of the small anatomical difference between the two genera, recognition of *Latiromitra* and *Ceratoxancus* as valid genera may have to be re-evaluated in the future. *Ceratoxancus basileus*, which lacks a labral fasciole and has obsolete axial sculpture on the last adult whorl, strongly resembles species of *Latiromitra*. It was placed in *Ceratoxancus* based on anatomical characters (salivary glands not fused). *Latiromitra* differs from *Metzgeria* Norman, 1879, by its rather flat whorls and short, broad siphonal canal.

Summing up, the genus *Latiromitra* appears to be widely distributed at bathyal depths at low latitudes in the Atlantic and Indo-West Pacific. Currently, we include the following species in the genus:

Latiromitra aratiuncula (Quinn, 1981). Recent, Caribbean.

L. barthelowi (Bartsch, 1942). Recent, Philippines and Indonesia.

L. cacozeliana sp. nov. Recent, Vanuatu.

L. crosnieri sp. nov. Recent, Madagascar and NE of Fiji.

L. cryptodon (P. Fischer, 1882). Recent, tropical and subtropical Atlantic.

L. delicatula (Shikama, 1971). Recent, South China Sea and off Taiwan.

L. meekiana (Dall, 1889). Recent, Caribbean.

L. okinavensis (MacNeil, 1961). Pliocene, Okinawa—Recent, Kyushu.

L. paiciorum sp. nov. Recent, New Caledonia.

?*L. styliola* (Dall, 1927). Recent, southeastern United States.

L. vitilevensis (Ladd, 1982). Pliocene, Fiji.

Species excluded from *Latiromitra*

Benthovoluta nakayasui Habe, 1976

Benthovoluta nakayasui: Habe, 1976: 98, 99, pl. 1, fig. 1.

Cyomesus nakayasui: Harasewych, 1987: 178.

Harasewych (1987) transferred *Benthovoluta nakayasui* Habe, 1976 to *Cyomesus*. We have not examined the type material from off Taiwan in 150 m, but according to the photograph published in the original description, the holotype is very similar to specimens of *Borsonia symbiotes* (Wood-Mason & Alcock, 1891) [= *B. sub-*

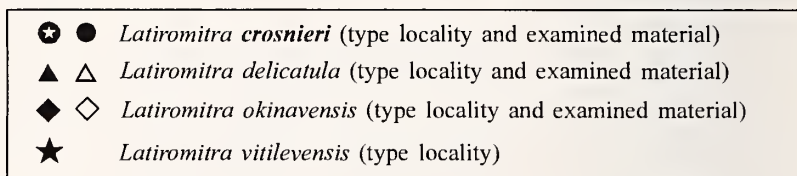


Figure 12

Distribution of *Latiromitra crossnieri* Kantor & Bouchet, sp. nov., *L. delicatula*, *L. okinavensis*, and *L. vitilevensis*.

corpulenta (E. A. Smith, 1899) = *B. ochracea* (Thiele, 1925)] from the Philippines and Indonesia in MNHN (A. V. Sysoev, personal communication).

In the original description Habe mentioned "weak growth lines sinuating below the suture as in the family Turridae," as well as three plaits on the columella. *Borsonia symbiotes* also has columellar folds, usually a single one, but three folds are present in one of the specimens examined. Neither radula nor operculum was studied by Habe. Therefore we think that *Benthovoluta nakayasui* should be transferred to the family Conidae [*sensu* Taylor et al., 1993] and probably synonymized with *Borsonia symbiotes*.

Fasciolaria (Mesorhytis) costata Dall, 1890

Fasciolaria (Mesorhytis) costatus Dall, 1890:317, pl. 5, fig. 5.

Benthovoluta costata: Cernohorsky, 1973:129.

Cyomesus costatus: Quinn, 1981:74, 75, fig. 2.

Fasciolaria (Mesorhytis) costata is a small (shell height 13.6 mm) deep-water Caribbean species known only from its dead holotype collected in 1256 m. The inclusion of the species in *Cyomesus* (= *Latiromitra*) is prob-

lematical. The shell has very convex whorls with widely spaced axial folds, also present on the last adult whorl. These differences between *F. costata* and other species of *Latiromitra* seem sufficient to exclude it from that genus and place it tentatively in *Metzgeria*.

Vexillum (Latiromitra?) [sic] problematicum Ponder, 1968

Vexillum (Latiromitra?) [sic] problematicum Ponder, 1968: 45, pl. 4, figs. 55, 56.

Latiromitra problematica: Dell, 1995: 19, fig. 22.

This species from 86–540 m (dead collected) off SE New Zealand was tentatively attributed by Ponder to the subgenus *Latiromitra*, since the radula was unknown. Dell (1995) reported 14 additional dead collected specimens from Papanui Canyon, Otago, and off the Antipodes Islands. The shell has very convex whorls with widely spaced axial ribs, suggesting a position in *Metzgeria* rather than *Latiromitra*.

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